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Method for a Systematic Evaluation of advanced Complexity Management Maturity

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Abstract

Dealing with the strongly increasing complexity of the company itself and its environment has become a key competitive factor. Companies can only face the progressively increasing external complexity in global markets with an appropriate "healthy" internal complexity. It inevitably has to be adapted to market demands. If the internal complexity is too low, the external complexity cannot be mastered sufficiently. The complexity management in the company is therefore not effective. If the internal perspective is too high, the company thus has unnecessary efforts and the complexity management is not efficient.

The complexity within socio-technical organizations such as e.g. value networks or industrial companies is characterized by the difficulties and turbulences encountered in daily business and can be described by four dimensions: variety, heterogeneity, dynamics and non-transparency.

Most companies have not introduced or implemented a complexity management system in order to deal with these issues yet. Many companies do not know if the used management activities are efficient, effective and adequate. Therefore, companies have to be reviewed and evaluated regarding their complexity management maturity.

Maturity models can be used to support the analysis and assessment of skills and development levels of products, processes or organizations. Such competence models are using defined levels of maturity, which can be used to describe the different achievable skill levels. Maturity models for the purposes of evaluation issues have several benefits such as finding vulnerabilities and identifying improvement measures, a better control over costs and time or an earlier and more accurate predictable release and introduction of complexity management activities.

This paper presents basics of an advanced Complexity Management as well as an approach for a systematic evaluation of advanced Complexity Management maturity, describing the different levels and taking into account recommendations to increase the degree of maturity.

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Keywords: Complexity Management; advanced Complexity Management; Maturity model

1. Introduction

Economic policy megatrends such as demographic change, climate change or increasing digitalization are key drivers for the current and future success of worldwide socio-technical organizations [1-2]. In addition, the rise of many developing countries leads to the emergence of new power centers and a new balance of forces in the global markets; the consolidation pressure is increasing in Western countries. The trend of increasing digitalization and current developments towards the so-called fourth industrial revolution to Integrated Industry (Industry 4.0) show that in the near future there will be demand and potential for tremendous flexibility and adaptability of value networks [3]. These developments pose a

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challenge on socio-technical organizations, e.g. global value networks or industrial companies, including their production and supply chain, with a variety of complex design and decision tasks.

The complexity of the business environment is constantly growing and thus socio-technical organizations face new challenges. Even within the socio-technical system, the complexity grows e.g. in organization, processes and other business areas. The significant increase in complexity is already perceived by industrial companies worldwide [4]. In a study of Camelot Management Consultants AG [4], 83 % of the surveyed senior executives regard the achieved complexity level in their companies as being too high. In a study of Fraunhofer IPA, 82 % of the interviewed managers think that the relevance of complexity will grow [5]. A study of IBM Corporation [6] with chief executive officers worldwide documents three substantially matching views. First, the respondents expect that the soaring increase of complexity becomes their highest challenge to solve. Second, the enterprises are not able to deal with this global complexity effectively. Third, the participants identify creativity as the most important leadership skill for enterprises that want to find their way through the complexity challenges. Despite the growing importance, only 11 % [4] (16 % [5]) of the companies have access to adequate tools for complexity management. There is great potential for improving socio-technical systems across many industrial sectors such as automitive, machine building or aerospace industry.

This paper presents the basics of the new approach of advanced Complexity Management in socio-technical organizations. This new approach includes strategies that implicate the product complexity and its active influence of the socio-technical organization's internal complexity and performance as well as the linked complexity pricing. Furthermore, an approach for a systematic evaluation of advanced Complexity Management maturity is presented.

2. Up-to-date survey on complexity management and maturity model approaches

Every field of science and technology defines and explores complexity in its own way. Since a consistent concept is missing, the existing approaches concentrate on different aspects of complicacy and complexity. For a more compact overview in this paper, existing approaches in the field of socio-technical systems are grouped as follows: quantification of complexity in socio-technical organization as well as maturity model approaches.

2.1 Quantification of complexity in socio-technical organization

In the theoretical approach of Kaluza [7] complexity dimensions of value networks are described with simple mathematical formulas. In Wilson's practical method of triangulation [8] complexity is quantified, but not in an exact scientific method. The approach of the international complexity management in the automotive industry of Schoeller [9] focuses on the product complexity and its impact on process and organization. The complexity of value distribution according to Schuh [10] serves as a model for the representation and design of the system behavior of production networks in the site and site structure planning. In the model of Giessmann [11], the causal relationships of analytical complexity in logistics are described empirically. In the approach used by Lammers [12] for complexity management of distribution systems, complex vectors are elaborated, based on subjective management decisions which serve as subsequent recommendations for strategic decisions. In the design model of Mayer [13] for the management of complexity in industrial logistics, the logistics is modularized to the economic modules, in order to optimize the logistics management using suitable instruments. In the method of Meyer [14], the requirements of complexity management in the strategic management process of logistics are integrated, based on an approach of the Balanced Scorecard. The complexity evaluation model by Blockus [15], based on the Analytic Network Process (ANP), which is based essentially on the model of the mathematician Saaty [16], is an approach to solving decision problems. The model of Blockus is specifically designed to determine the complexity of service companies.

A unified picture of complexity management is missing. Although complexity management comprises theoretical methods to manage the existing complexity, a unified understanding has not been achieved. There is a lack of transparency and no coherent overview on the number and diversity of methods and tools united under the umbrella of complexity management.

2.2 Maturity model approaches

Since the introduction of the first maturity models a wide range of maturity models have been developed by representatives of the practice as well as scientists. In addition to software companies and consultancies diverse maturity models are proposed by scientific community [17-18]. While at the beginning of the development the main goal of maturity models was the optimization and evaluation of the information system engineering and software development, maturity models today are being developed increasingly for business engineering.

Two definitions of maturity models can be mentioned:

"A maturity model is a (simplified) representation of reality to measure the quality of business processes. Here, depending on the model, different stages of "maturity" of business processes are described." [19]

„A maturity model conceptually represents phases of increasing quantitative or qualitative capability changes of a maturing element in order to assess its advances with respect to defined focus areas." [20]

Both definitions have been used as a basis for the porposed approach decribed in this paper.

Maturity models are based on the assessment of competency objects aiming at consistent and verifiable statements about these objects' (processes and organizations), current status and quality of their execution [21-23]. The levels/stages of maturity within such existing models are used to describe different achievable skill levels. In general maturity models provide methods for the assessment of skill